TAILORING ALLOY, ANODIZE AND LUBRICANT MAY IMPROVE BEARING CHARACTERISTICS OF ALUMINUM

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The type of anodic coating appears to significantly influence the performance of individual dry film lubricants on aluminum, according to tests recently conducted at North American Aviation's Space and Information Systems Division. In addition, since the properties of anodic conversion coatings depend upon the parent metal, it would appear that the best coating for optimum dry film lubricant performance might well vary from one aluminum alloy to the other. The investigation examined two proprietary dry film lubricants on aluminum specimens prepared with three different anodic coatings: chromic acid, sulfuric acid and hard anodize.

Although the effect of surface finish on the life of dry film lubricant coatings is well recognized, most work and most published data have been done on steel bearing surfaces. This is because aluminum has been little used as a bearing material and also because of the difficulty of testing friction and wear characteristics of aluminum in the laboratory.

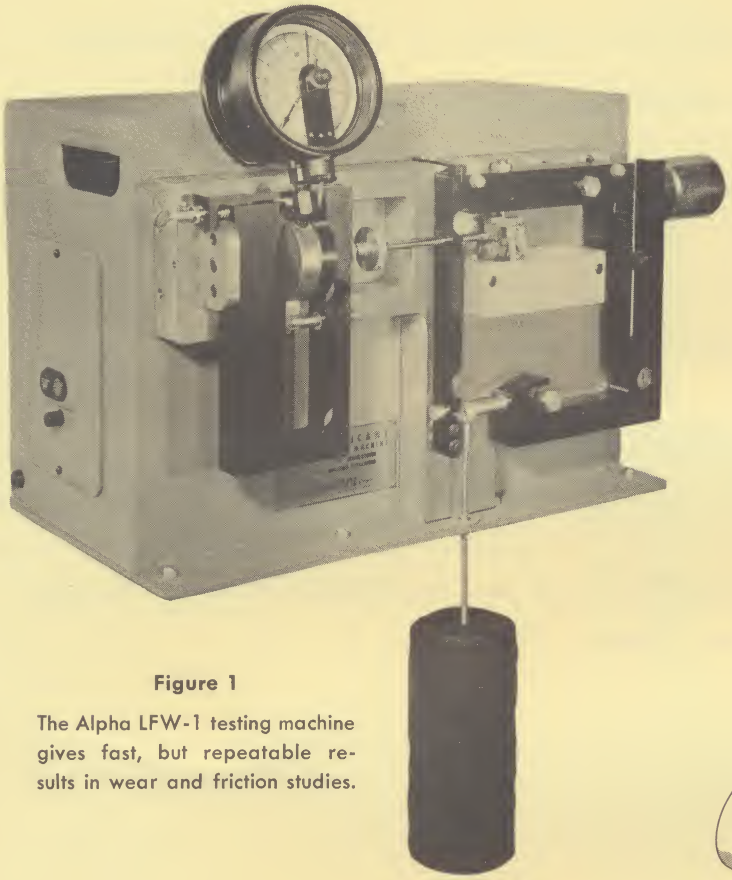
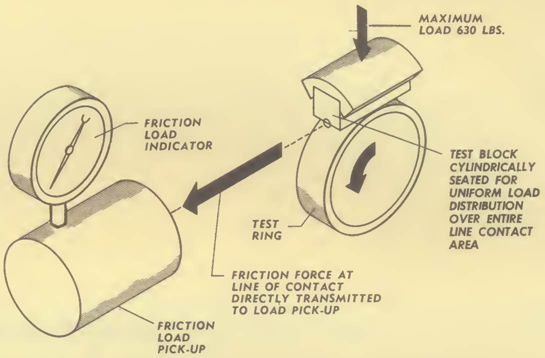


Figure 1

The Alpha LFW-1 testing machine gives fast, but repeatable results in wear and friction studies.

Figure 2

This force diagram demonstrates the rugged simplicity of the Alpha testing machine.



The destructive nature of most lubricant testers has made it difficult to obtain significant data on extreme pressure aluminum-lubricant systems.

The tester used in this study is an Alpha LFW-1 Friction and Wear Testing Machine (Figure 1) manufactured by Dow Corning Corp. at Stamford, Conn. This machine is capable of measuring wear rate and kinetic coefficient of friction at surface speeds from 0.2 to 72 ft. per minute. An extremely accurate compound loading system can apply loads to 630 lbs. for a maximum average pressure of 110,000 psi in the line contact area between the circular test ring and rectangular test block. Friction force is indicated on a dial indicator. Figure 2 is a force diagram of the tester.

For the tests, test rings of 2024-T4 aluminum were machined to a 15 microinch rms finish. Test blocks of the same material were finished to 6-12 microinch rms. (Figure 3). Individual rings and blocks were anodized by three different treatments, chromic acid,

THE EFFECT OF ANODIC COATINGS ON WEAR LIFE OF DRY FILM LUBRICANTS ON 2024 ALUMINUM

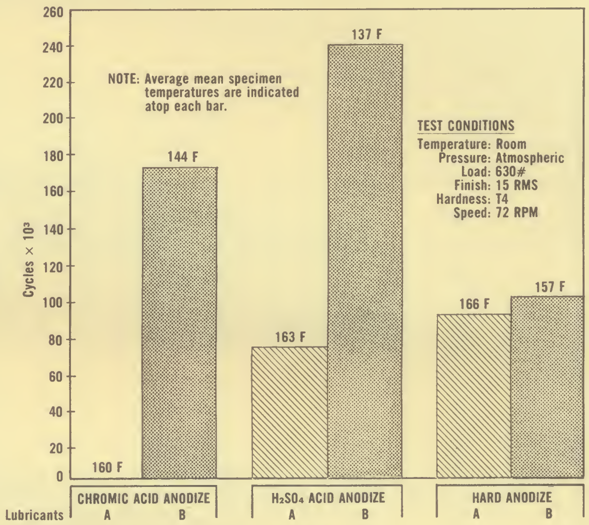
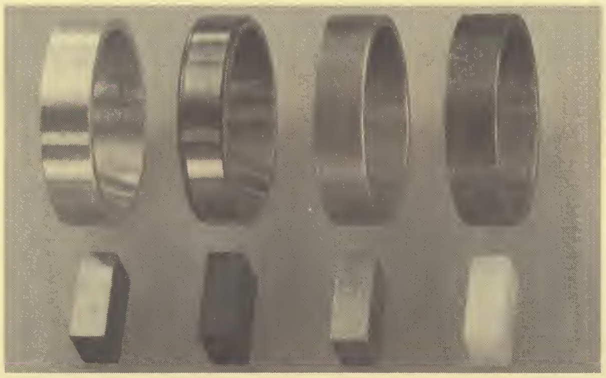


Figure 3

Block and ring specimens of any material are available from Dow Corning.



sulfuric acid and hard anodize (Mil-A-8625A). Then dry film lubricants A and B were applied to rings having each type of coating.

Test rings were placed on the tester mandrel, and, after degreasing, test blocks were mounted in their holder. A normal load of 630 lbs. was applied. Wear scar measurements of one specimen after 5,000 and 10,000 cycles indicated that this load produced a bearing pressure of approximately 49,000 psi. The tests were conducted with unidirectional sliding motion at room temperature and atmospheric pressure. A kinetic coefficient of friction of 0.175(M) was arbitrarily selected as the failure point. Temperature of the test block was monitored by means of a chrome-alumel thermocouple.

Test results are summarized in Table I. Note that film B provided better life on a sulfuric acid anodize surface, whereas film A gave slightly better results on the hard anodize specimen. In both cases the coefficient of kinetic friction was less on the

TABLE 1—THE EFFECT OF ANODIC COATINGS ON WEAR LIFE OF DRY FILM LUBRICANTS ON 2024 ALUMINUM

Lubricant	Type of Anodize	Average No. of Cycles	Average μ	Average Temp. °F.
A	Chromic	1,423	.101	160
B	Chromic	173,528	.026	144
A	H_2SO4	75,928	.047	163
B	H_2SO4	241,297	.024	137
A	Hard	90,146	.037	166
B	Hard	98,316	.021	157

hard anodized specimens. These data are presented graphically in Figure 4.

Although these tests were not extensive enough to be in any way definitive, the following preliminary conclusions can be drawn:

1. Each combination of aluminum alloy, anodic coating and dry film lubricant should be investigated if optimum performance is sought.

2. Optimization of alloy, coating and lubricant may well improve the load carrying capacity of aluminum to the extent that it can be more widely considered as a bearing material.

3. Meaningful, non-destructive tests of the friction and wear characteristics of aluminum can be accomplished by commercially available test equipment.

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